Space Weather Technical Forecast

Issued on Saturday, 07 September 2024 at 01:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares are likely through the period. Chance of G1/Minor Geomagnetic Storm conditions later Day 1 and on Day 2 (07 and 08 Sep). Slightly increasing chance of S1/Minor Radiation Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Low, with a peak C8.0 flare observed at 06/1919 UTC from AR3806 in the southwest. There are currently eleven sunspot regions on the visible disc. Ex-AR3807 has now passed beyond the southwest limb. AR3813 in the southeast remains the largest region on the disc and has seen the emergence of at least one delta spot over the past 24 hours. A complex region to the east of AR3813 has been newly numbered AR3815. This region has seen the formation of a marginal delta spot in its trailing portion. AR3806 and AR3611, both moderately sized regions, support Beta-Gamma classifications having lost their delta spots. The remaining sunspot groups on the disc are smaller and more magnetically simple.

No Earth-directed CMEs were observed in the last 24 hours. A filament eruption from the southeast disc earlier on 06 Sep is not considered to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind as measured by ACE and DSCOVR at L1 varied between slow-ambient and slightly elevated levels, generally between 350-410km/s. Density was below average. The Interplanetary Magnetic Field, Bt, was predominantly Weak (generally 5-7nT), but briefly increased to Moderate levels around 06/1103 UTC (peak 9nT). The north-south component, Bz, varied weakly throughout but has remained predominantly northward (+Bz) directed. Phi angle was almost exclusively negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 has continued to slowly decline following the response to the M5.5 flare on 01 Sep. It remains above but close to normal background levels and is well below the S1/Minor Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to Moderate levels, peaking at 187 pfu at 06/1255 UTC. The corresponding 24-hour fluence showed a steady then falling trend well below the Active threshold, with 2.84xe6 integrated pfu observed at 07/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Overall, Moderate activity is likely, with a very slight chance of isolated X-class (Strong) flares. This X-class risk decreases slightly by Day 2 (08 Sep) as Ex-AR3807 rotates well over the west limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the current forecast. A weak high-speed stream associated with CH65/+ in the northern hemisphere is anticipated to arrive later Day 1 and persist through Day 2 (07-08 Sep) resulting in slightly elevated wind speeds. Otherwise background wind speeds are expected.

Geomagnetic activity is forecast to be largely Quiet. Later Day 1 activity is expected to reach

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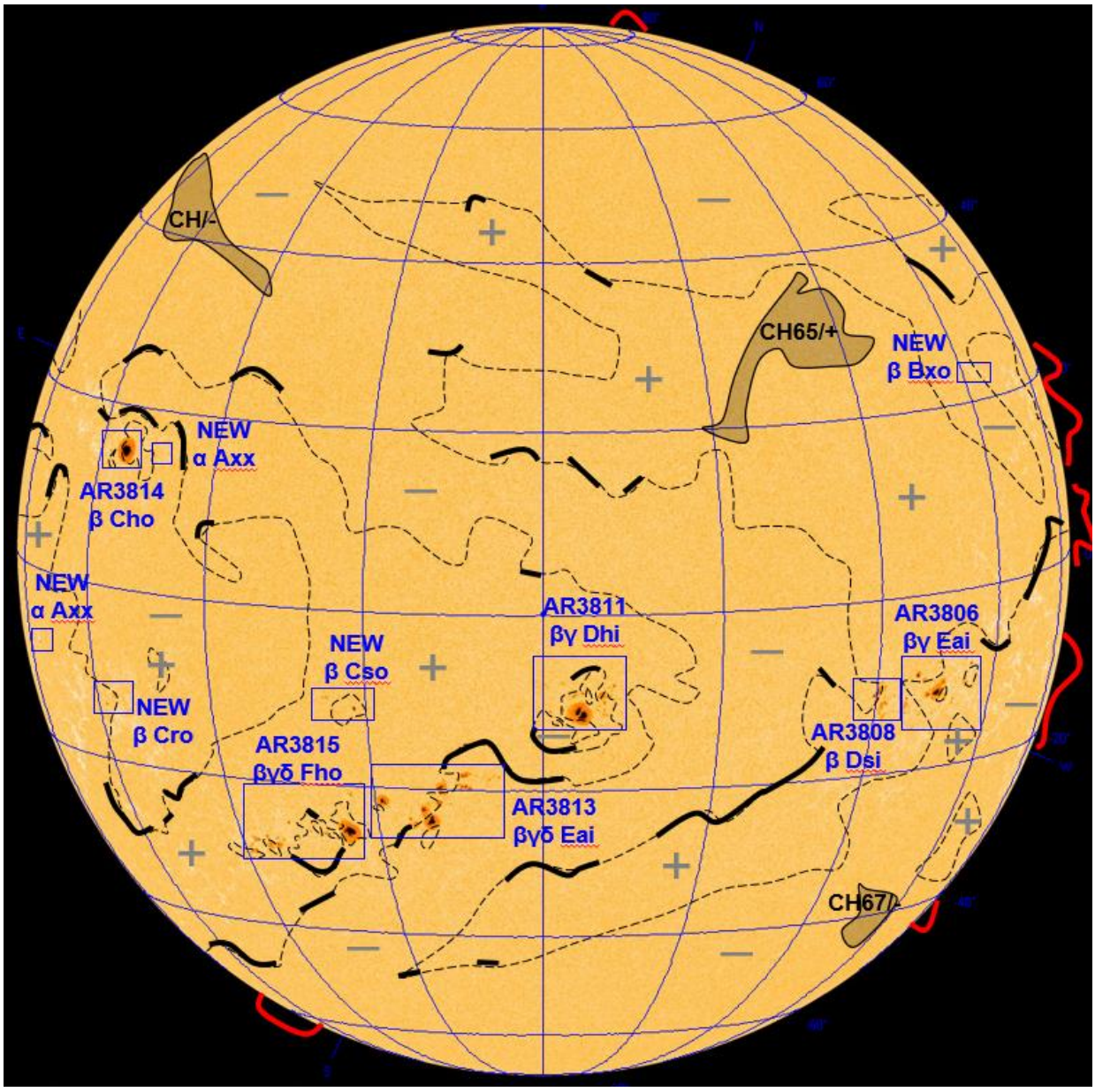
Unsettled to Active levels with a chance of peak a G1/Minor Storm (Kp 5) interval late Day 1 or early Day 2 (08 Sep) owing to coronal hole fast wind interaction. Activity should subside to largely Quiet to Unsettled levels again by Day 3 (09 Sep).

Energetic Particles / Solar Radiation: High energy proton flux is around background levels, but well below the S1/Minor Radiation Storm threshold. There is a slight but increasing chance of exceeding S1 levels in the coming days should any strong flares occur. High energy electron flux is expected to remain at background to moderate levels, perhaps rising late in the period following any HSS effects to see diurnally high levels. There is a slight chance of fluence reaching the Active threshold by the end of the period.

Figure 1. Solar Analysis Valid 06/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the current forecast. A filament disruption from the southeast disc on 06 Sep produced a faint CME, this is not considered to have an Earth-directed component.

Two coronal holes are located in the western disc with a faint coronal hole close to the northeast limb. CH67/- is at mid-latitudes in the southern hemisphere and with Earth situated north of the solar equator it is not expected to become geo-effective. Larger CH65/+ in the northern hemisphere is considered much more likely to connect with Earth, beginning later on Day 1 (07 Sep). Only slightly elevated wind speeds are considered likely at peak between Day 1 and Day 2 (07-08 Sep). This coronal hole on the previous rotation was in a slightly different location, and the solar wind was contaminated by CME arrivals, so persistence is not reliable. However, the coronal hole being positive it is more likely to give a notable geomagnetic response at Earth at this time of year. MOSWOC Enlil is currently significantly overestimating the wind speed, modelling a broad and strong coronal hole which does not exist. SWPM appears to be giving a reasonable steer of around 450-480 km/s.

Geomagnetic activity is forecast to be largely Quiet, but expected to reach Unsettled to Active levels later Day 1 with a chance of a peak G1/Minor Storm (Kp 5) interval late Day 1 or early Day 2 (08 Sep) owing to coronal hole fast wind interaction. Activity should subside to largely Quiet to Unsettled levels again by Day 3 (09 Sep).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth-directed CMEs are currently expected.

Figure 2: MOSWOC Enlil showing elevated winds that are not reflected in reality.

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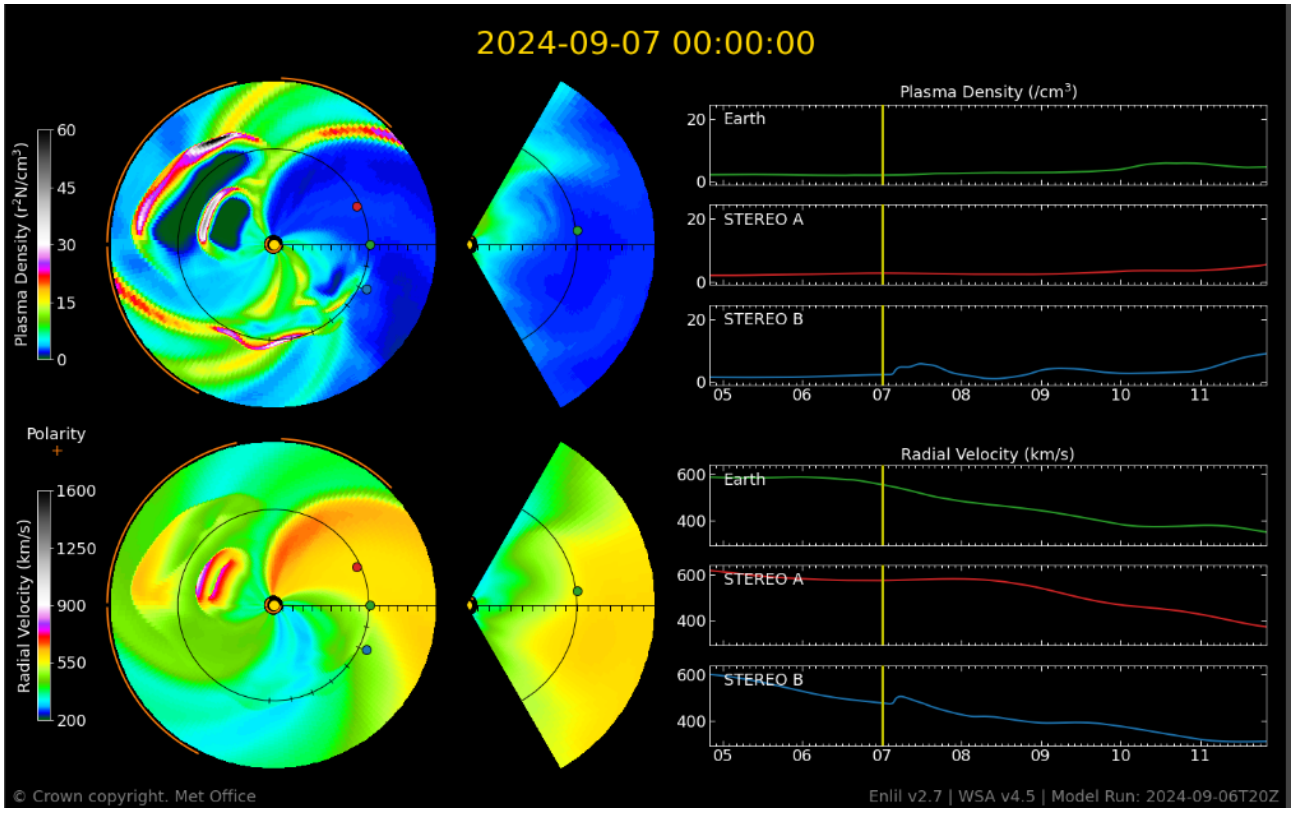
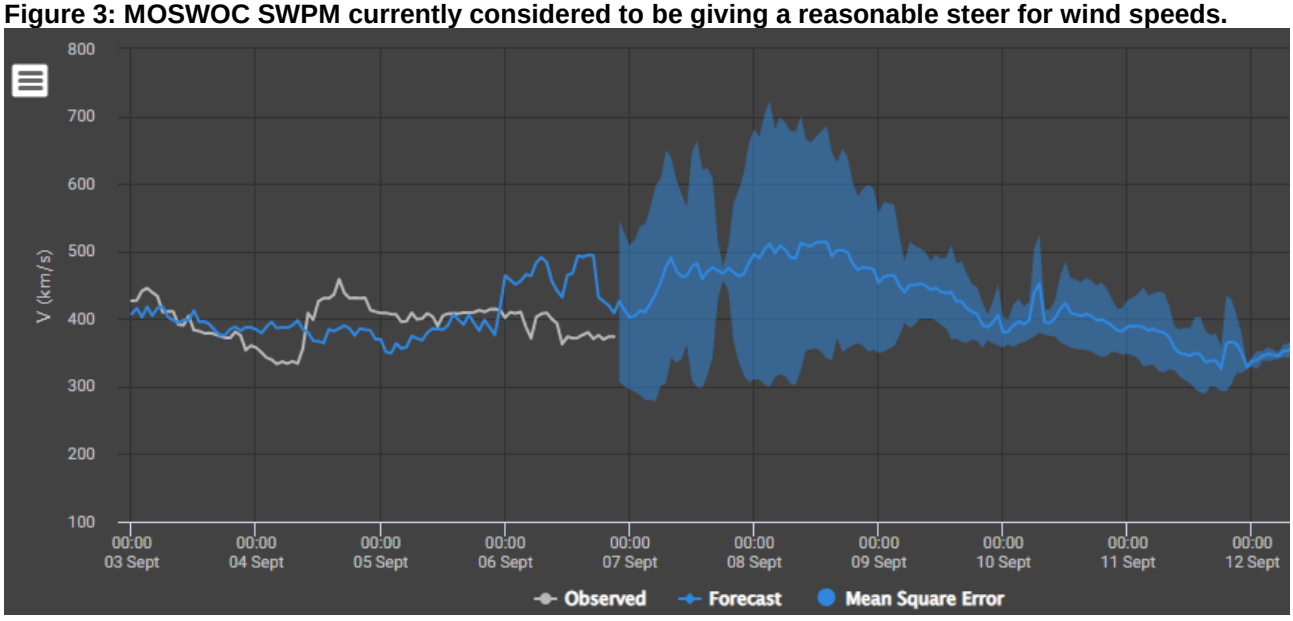


Figure 3: MOSWOC SWPM currently considered to be giving a reasonable steer for wind speeds.



Radio Blackouts - X-Ray Flares:

There are currently eleven sunspot regions on the visible disc and one recently departed region, AR3807 (Fho/Beta-Gamma) or Ex-AR3807.

AR3813 (Eai/Beta-Gamma-Delta), in the southeast, remains the largest region on the disc and has maintained a small delta configuration in the leading portion of the group and seen the emergence of a larger delta configuration on one of the more mature trailing spots through 06 Sep. The region to the rear of this has been newly numbered AR3815 (Fho/Beta-Gamma-Delta) and has a marginal delta configuration in its trailing portion.
Several small and simple regions have emerged during the past 24 hours. The remainder of the

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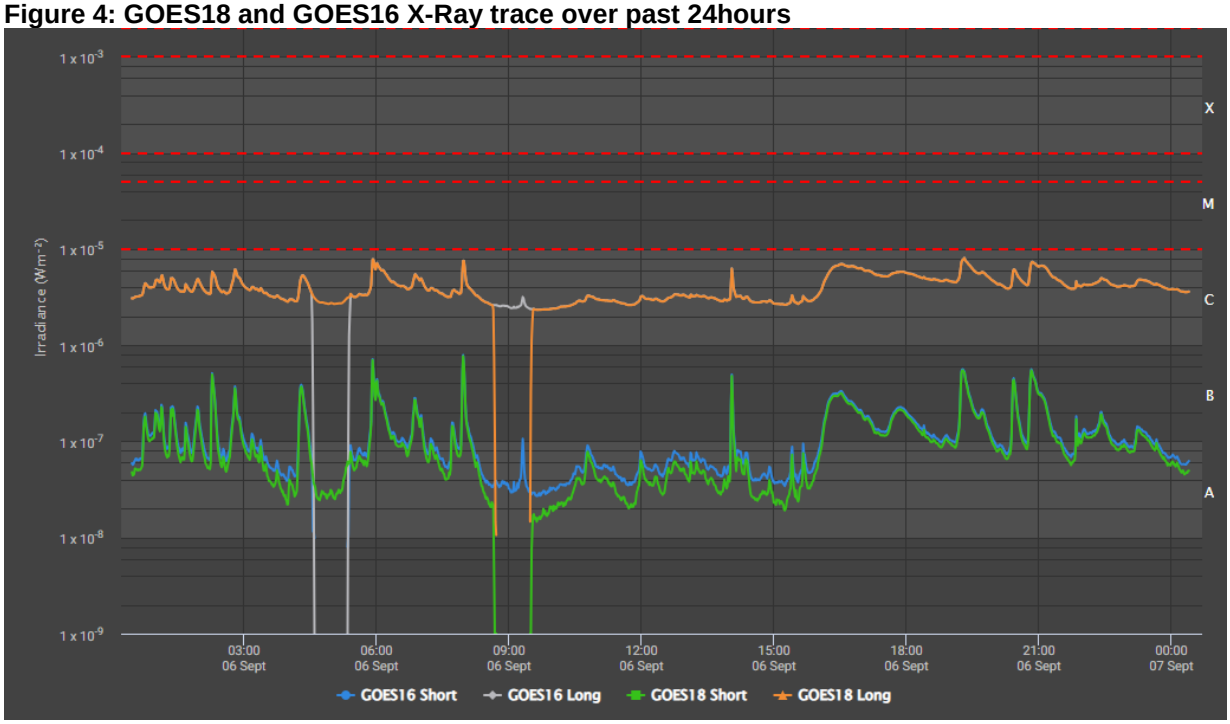
regions are smaller and more simple and did not exhibit significant growth or decay during the recent period.

AR3807 departed the disc during 06 Sep but still poses a contribution to flare risks at GOES through Day 1 (07 Sep) as it rotates further away from the limb, onto the far side of the visible disc. A new or returning region may emerge across the eastern limb during Day 4 (10 Sep).
Activity has been Low over the past 24hrs, with occasional moderate to high C-class flares observed. Despite the recent reduction in flare activity, the risk for Moderate flares remains likely with an ongoing very slight chance of an isolated X-class flare. The risk of X-flares decreases very slightly by Day 2 (08 Sep) as AR3807 rotates well over the west limb.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	10	5	5	5

Figure 4: GOES18 and GOES16 X-Ray trace over past 24hours



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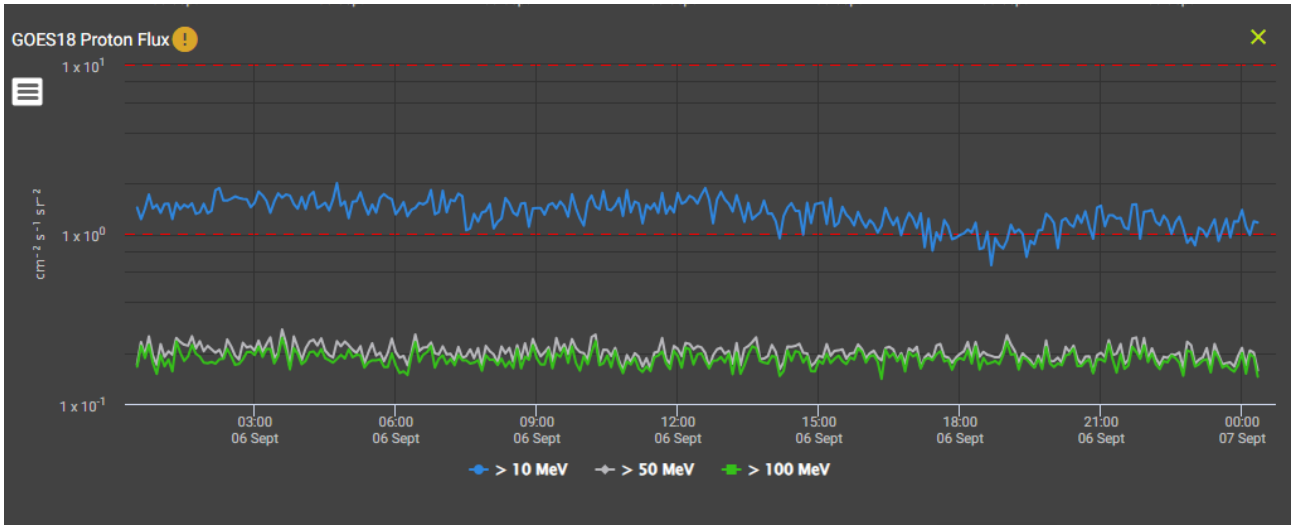
Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18 continues to ease following the response to the large eruption and associated M5.5 flare off the southeast limb on 01 Sep. Levels are now fluctuating between slightly elevated and normal background conditions. It is considered unlikely to reach the S1/Minor Radiation Storm threshold, in the absence of further notable flares.
There are several regions on the disc that could give an increase in proton flux, should they produce larger flares, including AR3806, Ex-AR3807 and AR3808. In the case of Ex-AR3807 the risk of proton response from any flares should significantly diminish by Day 2 (08 Sep) as it rotates further beyond the western limb.

Usually, AR3813 would be considered a low risk of exceeding S1/Minor Storm levels from its current location in the southeast quadrant. However, given that it has already produced a proton response at Earth at a time when it was closer to the east limb (on 01 Sep) this region is considered to pose the greatest risk of producing radiation storms, especially as it rotates westward into a more geo-effective location on the visible disc.
Overall, there is a slight but increasing chance of reaching the S1 threshold in the coming days, should there be any larger flares, predominantly from any of the aforementioned regions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: GOES18 Proton flux trace



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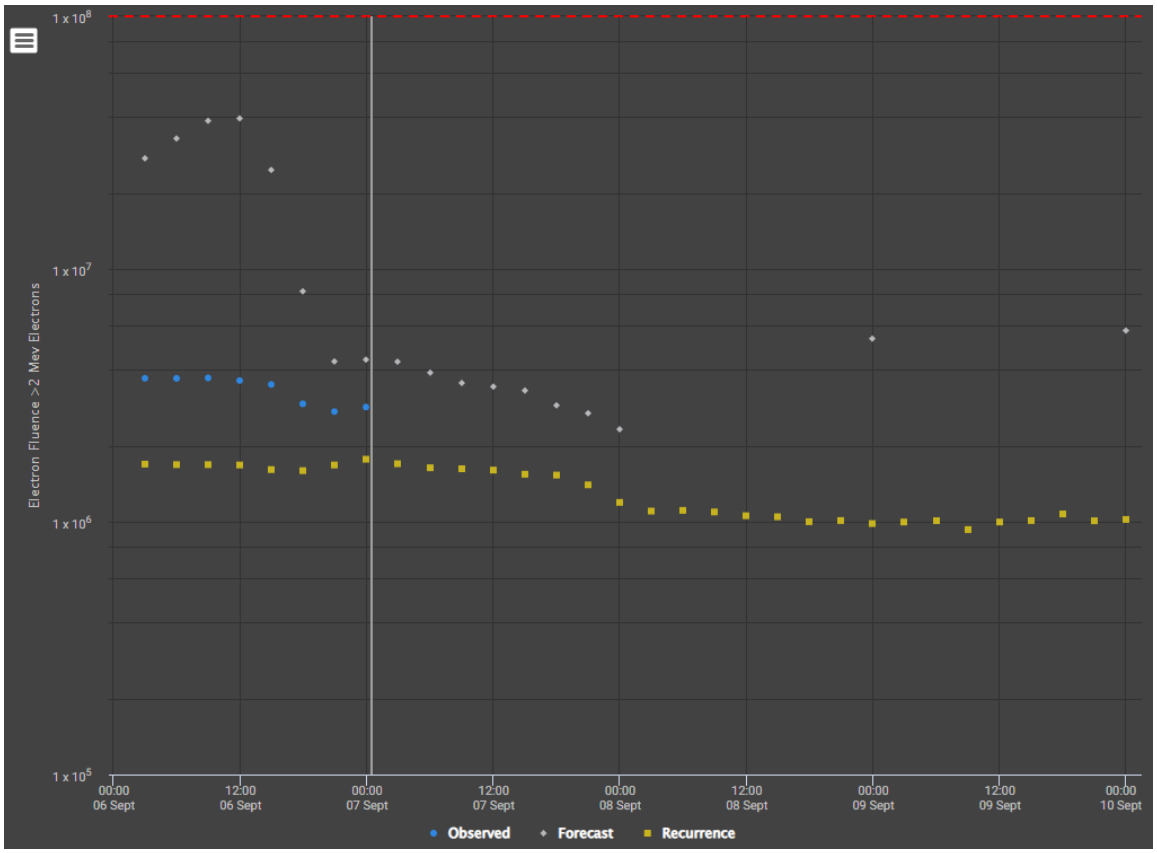
High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES-16 has been at background to moderate levels. Any weak HSS from CH65/+ may result in a slight increase in the electron flux, with levels becoming mainly moderate, with a slight chance of reaching High levels during a diurnal peak.

Overall, the 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold, although with perhaps with a rising trend late in the period after any HSS from CH65 starts to ease. Therefore, there is a slight chance of exceeding the Active threshold by Day 4 (10 Sep). MOSWOC REFM will not be taking into account the upcoming potential HSS, but the overall trend of the fluence remaining below Active is accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: MOSWOC REFM



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